PERFORATED CAPSULE FILTER

Field of the Invention

The present invention generally relates to a filter, and more particularly relates to an improved filter for smoking articles, such as cigarettes.

Background of the Invention

Several filter designs exist for smoking articles, such as cigarettes, cigars, and similar articles. Such filters traditionally are formed with different types of filtering media to reduce or eliminate undesirable components from inhalation by the smoker. Fibrous filters, such as cellulose acetate or paper commonly are used as filter media for tobacco smoke. In addition, activated carbon is used in conjunction with the fibrous filter to absorb certain tobacco smoke combustion by-products. As used herein, "activated carbon" or "carbon" refers to charcoal that is treated to result in a highly porous, highly absorbent filter media. Thus, generally, a smoking article may contain a charge of tobacco, a fibrous filter, and a metered amount of activated carbon.

While carbon plays an important role in the filtering process, the location of the carbon in the smoking article can lead to less than preferred results. The carbon typically is placed within the smoking article in an area within the fibrous filter during the assembly process. For example, the filter section of a cigarette can comprise a first fibrous filter, an amount of activated carbon, and a second fibrous filter. In this manner, the activated charcoal is intended to serve as an additional filter media through which the tobacco smoke must pass during suction by the smoker. Unfortunately, however, due to gravitational settling, the activated charcoal tends to fall, or

settle, within the filter. Thus, the smoker does not necessarily draw the tobacco smoke through the activated charcoal media. Rather, the tobacco smoke may take a path of least resistance and avoid the activated charcoal. Thus, current methods for using fibrous and carbon filter media do not make consistent or efficient use of the activated carbon media and also contribute to an inconsistent flavor as perceived by the smoker.

Another current deficiency in the use of activated charcoal is migration of the charcoal into the fibrous filter media. Most notably, black discoloration of the fibrous filter media can occur as the carbon rests against the fibrous filter. Potentially, a smoker may open a new pack of cigarettes but at least one cigarette may be discolored by the migration of the carbon through the fibrous materials. This can lead to consumer dissatisfaction.

There is a need, therefore, for an improved filtration application that overcomes the deficiencies of inefficient carbon filtration, inconsistent flavor, and undesirable migration.

Summary

The present invention overcomes the deficiencies of the prior art by providing a capsule that has a perforated outer shell that is substantially filled with the filtering media. The media may be carbon or other filtering media. Additionally, other flavorants or aromatic substances may be included to impart a specific taste or modify the smell of the tobacco smoke. Thus, the media within the capsule may be filtration media, taste-modifying media, aromatic media, or a combination thereof.

The present invention also provides an insert for a smoking article. The insert is the capsule of the present invention; namely, a perforated shell with media substantially filling the cavity formed by the shell. The capsule is placed within the smoking article at a point between

the tobacco and the point of inhalation such that, upon inhalation, the tobacco smoke is drawn through the media. The capsule may be so placed either during manufacture of the smoking article, or as part of an after-purchase smoking accessory such as a cigarette holder or the like.

More broadly, the present invention also provides a filter for any in-line application between a polluted source and a substantially pollutant-free product. The filter is the capsule of the present invention; namely, a perforated shell with media substantially filling the cavity formed by the shell. The capsule is placed at an effective point between the source and the product and the media substantially filters the contaminant as the material flows through the perforated, media-filled capsule.

These and other aspects of the present invention as disclosed herein will become apparent to those skilled in the art after a reading of the following description of the preferred embodiments.

Brief Description of the Drawings

Figure 1 is a schematic plan view of an automated process for producing perforated capsule filters.

Figure 2a is a cross-sectional view of a smoking article including an embodiment of the apparatus of the present invention.

Figure 2b is a cross-sectional view of a smoking article including another embodiment of the apparatus of the present invention.

Figure 3 is an elevation view of an embodiment of the present invention with a partial cut-away portion.

Figure 4 is a perforation pattern for a perforated capsule.

Detailed Description

As illustrated in Figure 1, one preferred method for forming the capsules of the present invention involves the modification of any standard hard capsule filling and closing machine 80, such as the Bosch GKF 1200, GKF 1500, or GKF 2000 distributed by Bosch Group of TL Systems Corporation of Minneapolis, Minnesota. While any filling and closing machine may be used, as shown in Figure 1, the machine 80 may include a turntable 20 which rotates among a plurality of process stations 1-12. One or more discrete process steps may be performed at each station 1-12. In the embodiment shown in Figure 1, empty non-perforated capsules 40 are delivered to the turntable 20 at station 1, and the capsules 40 are straightened and aligned for subsequent processing. Next, the capsules 40 are passed to station 2 for perforation of the ends of the capsules 40 by laser 30. Laser 30 may include a control unit 32 and a remote head 34. Laser light is directed from the remote head 34 to perforate the capsules 40. Preferably, both ends of the capsule shells 40 are perforated simultaneously, i.e. by passing beams of laser light through one end of the capsule shell 40, and out through the opposite end of the shell 40. Alternatively, the shell halves 50, 60 may be be separated prior to perforation, and each half 50, 60 may be perforated individually.

Any appropriate apparatus may be used to perforate the capsules, however, laser perforation is preferred for accuracy in placement and perforation size. One example of a laser that may be used for laser perforation is the Blazer 5000 or 6000 available from Lasertechnics® Inc. of Albuquerque, New Mexico. The capsules are perforated by directing a laser at the desired portion of the capsule. Laser beam strength and duration are selected to cause complete perforation through the top and bottom of the capsule with desired locations and perforation

diameters. Suitable diameters include, but are not limited to, about 0.05 mm to about 1.0 mm. Perforation size must be small enough to minimize escaping carbon or other media from within the capsule, but large enough to allow for the smoker to effectively draw air through the perforated, media-filled capsule. Further, preferably the perforations make up approximately 45% of each of the top and bottom end surface areas of the capsule. The perforations may make up more or less of the end surface areas of the capsule depending on the desired resistance to air flow through the capsule and/or the required size of webs or ligaments between the perforations necessary to maintain the structural integrity of the capsule.

Lasers have become increasingly common in consumer product manufacturing. For example, lasers are currently used to provide date codes on cartons and packages for consumer goods by selectively burning away ink from package surfaces with directed laser light. By burning away the surface color with the laser in this way, a mark is established due to the resulting contrast between the adjacent colored and non-colored portions of the package surfaces. Also, laser light may be passed through a mask or template such that a desired pattern of laser light impinges on a target surface. The portions of the laser light which pass through the mask or template burn away those portions of a surface color on the target surface which are exposed to the light, thereby establishing a desired contrasting image on the target surface.

Such lasers may also be used to produce a perforated capsule according to the present invention. The power or intensity of the laser light applied to a capsule surface is selected so that it is sufficient to burn through the upper and lower portions of the capsule when the capsule is empty. A template or mask having a desired hole pattern is used to selectively direct portions of the laser light onto the capsule surface. The hole pattern may include a variety of hole sizes and hole locations. The pattern should, however, leave sufficient webs or ligaments between

adjacent perforations so that the structural integrity of the perforated upper and lower portions of the capsule are maintained, while providing perforations which are sufficient to permit air to be adequately drawn through the capsule.

One perforation pattern which can be used in the present invention is illustrated in Figure 3 and Figure 4. In a preferred arrangement, the perforation pattern includes about 124 holes having diameters of about 0.25 mm, and about seventy-six (76) larger holes having diameters of about 0.5 mm. This combination of perforations provides openings in about 45 percent of the surface area of the perforated regions of the capsule to permit gas flow therethrough. Tests may be performed to determine the optimum number of perforations, perforation diameters, perforation locations, perforation patterns, perforation shapes, etc. that will provide sufficient structural integrity of a capsule while also permitting adequate gas flow through the capsule for a particular application.

Alternatively, the capsules may be perforated as the capsules are originally produced. For example, foaming agents may be added to the capsule shell material during formation of the capsules. As the capsule shells harden, the foaming agents leave behind voids or open cells in the thin capsule walls. By controlling the concentration of the foaming agent in the shell material, capsules having perforated walls with a desired permeability are produced. Such capsules eliminate the need to form a perforated hole pattern in the capsules using a laser or the like, thereby reducing filter production costs. Methods for using foaming agents to form open cells in a thin-walled material or membrane are disclosed in U.S. Pat. No. 5,853,633, which is hereby incorporated by reference in its entirety. The use of foaming agents to form open cells in other types of materials is disclosed in U.S. Pat. Nos. 4,800,214; 5,084,101; and 5,242,635. When such pre-perforated capsules are used, station 2 in Figure 1 can be eliminated.

Referring again to Figure 1, the perforated capsules 40 are separated into bottom capsule portions 60 and capsule caps 50 at station 3. The caps 50 may then be moved aside at station 4 to permit subsequent vertical filling of the bottoms 60. The bottoms 60 are then advanced to a dosing station 5. The dosing station 5 deposits fill material into the capsule bottoms 60. The composition of the fill material is discussed in more detail below. Preferably, the dosing station 5 includes a tamping apparatus to reduce the risk of inaccurate fill weights. Then, optionally, the bottom halves 60 may be subjected to further dosing at one or more subsequent dosing stations 6. The further dosing process may include dosing with other dosing materials that provide desired benefits such as flavor enhancers or the like. As discussed below, the capsules may contain a variety of fill materials.

After dosing, the capsule halves 50, 60 advance to an inspection apparatus at station 7 that ejects any defective capsule portions 50, 60. Then, the caps 50 and dosed bottoms 60 are realigned at station 8, assembled together at station 9, and closed at station 10. Thereafter, the filled and closed capsules 100 are discharged, and optionally sampled, by discharge apparatus 11. The recesses in turntable 20 are then cleaned using a cleaning device at station 12 as is known in the art. The cycle is then repeated to produce more perforated capsules 100.

A filled and perforated capsule 100 is illustrated in Figure 3. As shown, the capsule 100 has an outer shell 102 that defines a cavity 104. Within cavity 104, capsule 100 maintains fill material 106. The fill material 106 may be any material or combination of materials through which the polluted substance, e.g. tobacco smoke, is to be filtered or treated. Thus, for filtration or treatment of tobacco smoke, the fill material may be activated carbon or any other appropriate filtration material. An additional fill material may be the sodium salt of 2-mercaptoethane-sulphonic acid, also known as mesna, as described in U.S. Patent No. 4,532,947. The filter

material may be chosen to remove undesirable components such as tars, nicotine, volatiles, mutagens, carcinogens, saturated and unsaturated aliphatic aldehydes, polycylcic aromatic hydrocarbons, nitrosamines, combinations thereof, or the like. Further, the fill material may include a flavorant or aromatic substance to impart a desired flavor or aroma to the smoker. Additionally, combinations of filtering media, flavor-modifying media, and/or aromatic-modifying media may be included as fill material 106. One preferred combination for fill material 106 is activated carbon filtering media and menthol flavorant.

The capsule shell 102 may be formed of any appropriate materials, including but not limited to gelatin, polysaccharides (such as carrageenan), or a combination thereof. Another material that may be used to form the capsule shell is Hydroxypropyl methylcellulose or another cellulosic material. The shell 102 preferably is approximately 8 mm in diameter and approximately 3 to 12 mm in length. Thus, the capsule shell 102 may be oblong or cylindrical, for example as illustrated in Figure 2a, or substantially circular, for example as illustrated in Figure 2b. Although the size of the capsule may be formed appropriately for the desired amount of carbon filtration media 106, preferably the capsule shell 102 is formed to maintain therein about 200 mg to about 300 mg of carbon fill material 106, and most preferably about 250 mg of carbon fill material.

As illustrated in Figures 2a and 2b, as an insert for a smoking article, the capsule 100 is placed within the smoking article 110 at a point between the tobacco 104 and the point of inhalation 108. As used herein, the term "smoking article" shall include a cigarette, cigarette holder, pipe, cigar, or any other article that operates to hold a burning product and facilitates inhalation of at least a portion of the combustion products. Preferably, as shown in Figure 2b, the smoking article 110 includes a mouthpiece section 112 having a filter 107, made from

cellulosic materials. Most preferably, the capsule 100 is placed within the mouthpiece 112 between two cellulosic filters 107, as shown in Figure 2a. Alternatively, the capsule 100 may be integrated into the stem of a pipe in order to filter pipe smoke as it travels through the pipe stem (not shown). Still further, the capsule 100 may be integrated into a cigarette holder to filter smoke drawn from a conventional cigarette prior to inhalation by the smoker.

As will be appreciated by those skilled in the art, the capsule filter 100 of the present invention is equally useful as a filter for any in-line filtration application between a polluted source and a substantially pollutant-free product. Thus, the capsule 100 should be placed at an effective point between the source and the product point. The media substantially filters the pollutant as the pollutant flows through the perforated, media-filled capsule 100. Thus, although the preferred embodiment describes a filter 100 wherein the polluted source is a tobacco charge 104 to be smoked and the media is tobacco smoke-filtering media 106, the capsule 100 may be used for other applications. The filter 100 may be used as a portion of an after-market accessory filtration device which is configured to receive a conventional cigarette. Although specific embodiments of the present invention have been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. The above detailed description of the embodiment is provided for example only and should not be construed as constituting any limitation of the invention. Thus, modifications will be obvious to those skilled in the art, and all modifications that do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.